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Applicants: Brian J. Doerksen

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For: Alternate Furnace Tube Arrangement

Patent No.: 6,852,294

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Group Art Unit: 1764

Examiner: Alexa Doroshenko

Certificate
MAR 08 2005
of Correction

ATTN: Certificate of Correction Branch
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

CERTIFICATE OF MAILING

37 C.F.R. § 1.8(a)

Date of Deposit: 2/28/2005

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as First Class Mail on the Date of Deposit indicated above, and in an envelope addressed to: Certificate of Correction Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Typed or Printed Name: JOAN M. RONDEAU

Signature: Joan M. Rondeau

Dear Sir:

REQUEST FOR CERTIFICATE OF CORRECTION
PURSUANT TO 37 CFR § 1.322

Applicant hereby requests expedited issuance of a Certificate of Correction pursuant to 37 CFR § 1.322 to correct mistakes in United States Patent No. 6,852,294 B2 which are attributable solely to the fault of the United States Patent and Trademark Office ("Office"). A copy of US Patent 6,852,294 B2 is enclosed. The mistakes concern omitted text in Claims 1, 11 and 19.

As clearly disclosed in the records of the Office and as shown in enclosed photocopy of Applicant's Amendment and Response Under 37 CFR § 1.111 to the Office Action Mailed

10/28/2003, which was filed on April 28, 2004,

- Claim 1 was amended in lines 10 and 11 thereof to insert the words “and vertically” after the word “horizontally” (page 3);
- Claim 10 (re-numbered as Claim 11 in US Pat. No. 6,852,294) was amended in lines 9 and 10 thereof to insert the words “and vertically” after the word “horizontally” (page 4); and
- Claim 25 (re-numbered as Claim 19 in US Pat. No. 6,852,294 B2) was amended in line 8 thereof to insert the word “and” after the word “horizontally” (page 7).

As clearly disclosed in the records of the Office and as shown in the enclosed photocopy of the Notice of Allowance mailed October 5, 2004, Applicant’s amendments to Claims 1, 10 and 25 were entered by the Examiner.

The text of the corrections requested is set forth in the enclosed Certificate of Correction Form PTO-1050.

Because the mistakes are attributable solely to the fault of the Office, no fee is believed due. Nevertheless, the Commissioner is hereby authorized to charge any applicable fee for the requested Certificate of Correction and to charge any additional fees or credit any overpayment to Deposit Account No. 16-1575, ConocoPhillips Company, Houston, Texas.

Respectfully submitted,

Date: Feb. 25 2005

Anne E. Brookes

Anne E. Brookes

Reg. No. 33,066

ConocoPhillips Company - I.P. Legal

P.O. Box 2443

Bartlesville, OK 74005

Telephone: (281) 293-2542

Attorney for Applicant

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(12) **United States Patent**
Doerksen

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(45) Date of Patent: **Feb. 8, 2005**

(54) **ALTERNATE COKE FURNACE TUBE ARRANGEMENT**

(75) Inventor: **Brian Jay Doerksen, Ponca City, OK (US)**

(73) Assignee: **ConocoPhillips Company, Houston, TX (US)**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 299 days.

(21) Appl. No.: **09/872,390**

(22) Filed: **Jun. 1, 2001**

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(52) U.S. Cl. **422/200; 422/198; 422/200; 422/204; 202/124; 196/116; 196/117; 122/355; 122/359; 208/132**

(58) Field of Search **422/198, 200, 422/201, 202, 204; 202/120, 124, 125, 127; 196/116, 117; 122/155.1, 174, 355, 359, 236; 208/132**

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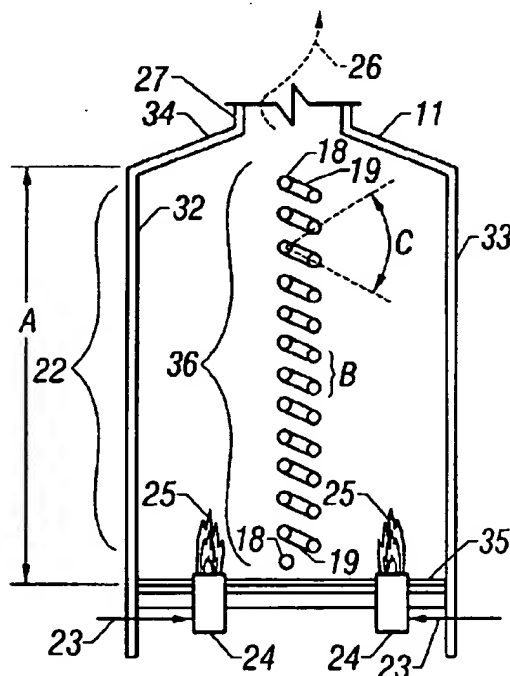
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Primary Examiner—Alexa Doroshenk

(57) ABSTRACT

Tubes within a radiant heating section of a coking furnace are arranged differently than in a single vertical column and connected together in a simple, planar serpentine pattern. The tubes are arranged in a plurality of offset or staggered vertical columns. This arrangement permits the upper tubes to be close to the radiant heat source and allows the tube bends connecting adjacent tubes to be of greater radius, so that the pressure at which the feedstock is passed through the tube bundle can be lower allowing more vaporization of the cracked process fluids.

32 Claims, 3 Drawing Sheets



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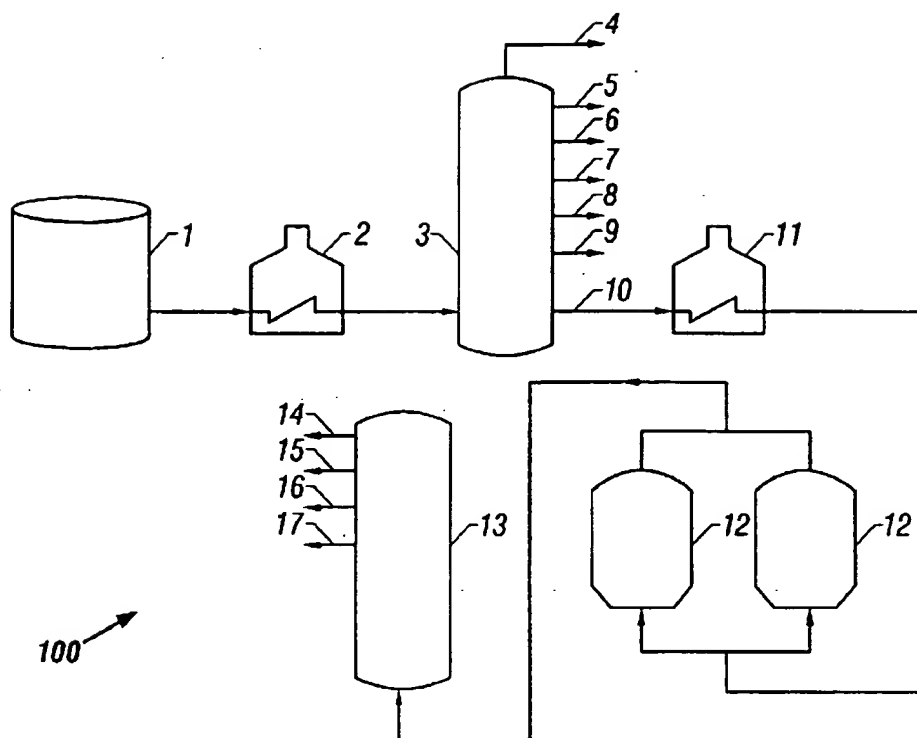


FIG. 1

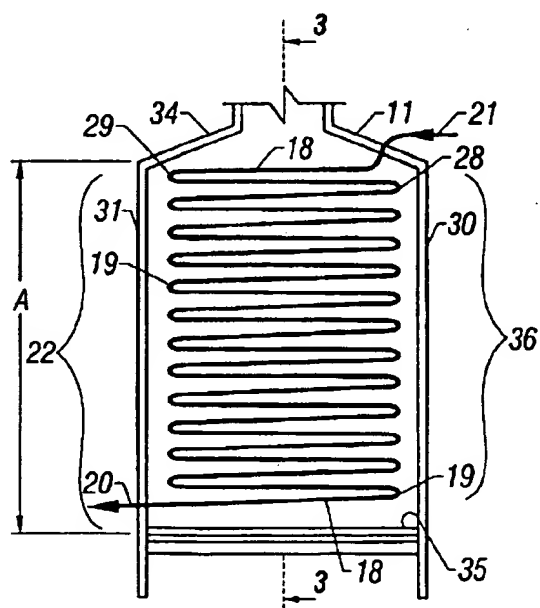


FIG. 2

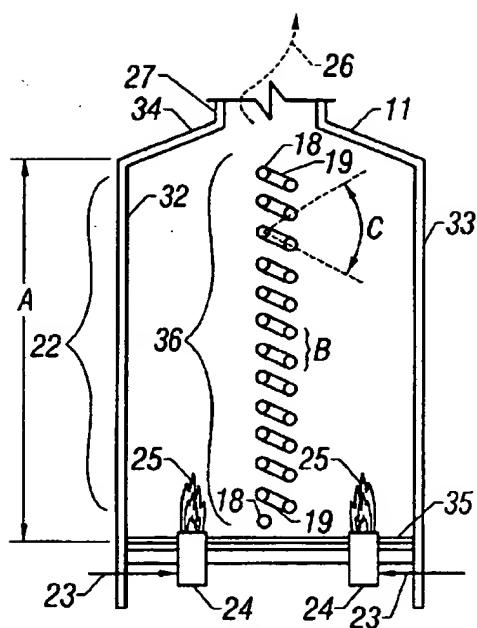


FIG. 3

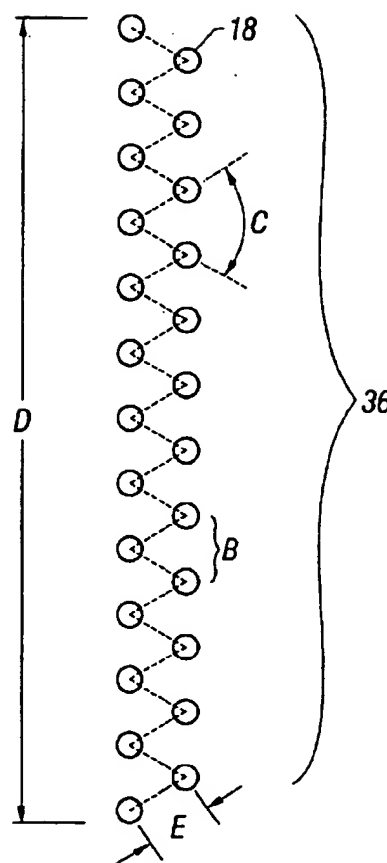


FIG. 4

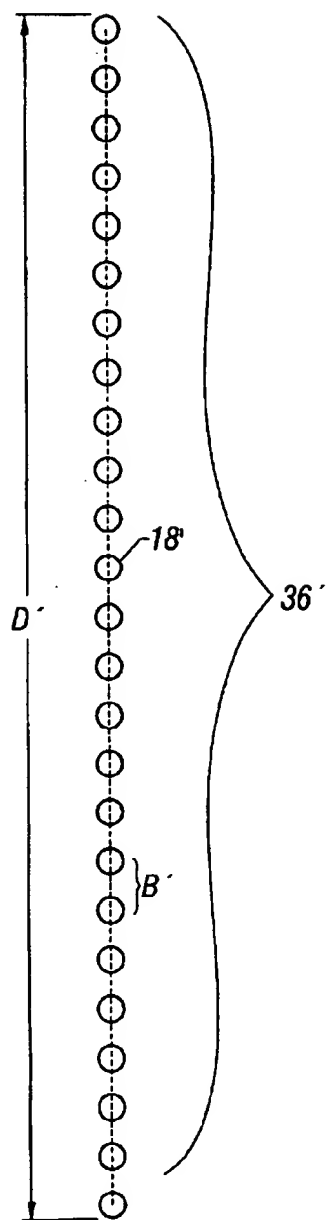


FIG. 5

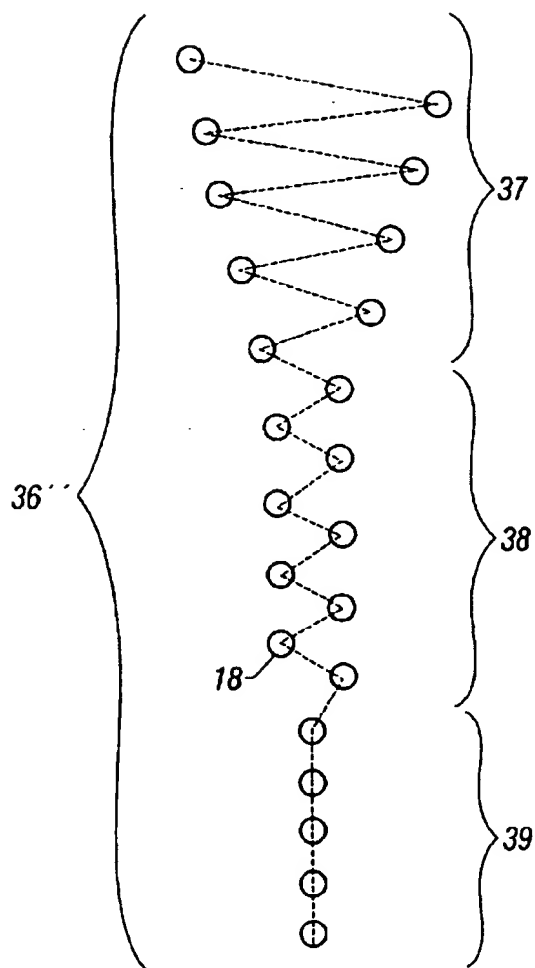


FIG. 6

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ALTERNATE COKE FURNACE TUBE ARRANGEMENT

FIELD OF THE INVENTION

The present invention relates to apparatus and processes for heating feedstocks in cracking heaters, and more particularly relates, in one embodiment, to apparatus for heating feedstocks in delayed coking processes by radiant heating. In a more particular aspect the present invention relates, in another embodiment, to a heater for use in heating the coking feedstock that is introduced into the coking drum in a delayed coking process and a novel coke furnace tube configuration.

BACKGROUND OF THE INVENTION

It is well known that coking is a severe thermal cracking process in which one of the end products comprises carbon, i.e. coke. The delayed coking process was initially developed to minimize refinery yields of residual fuel oil by severe cracking of feedstocks such as vacuum residuals and thermal tars to produce coke and lower molecular weight hydrocarbons. U.S. Pat. Nos. 4,049,538 and 4,547,284, the disclosures of which are incorporated herein by reference, show examples of delayed coking processes.

It is also well recognized that the delayed coking process generally involves heating the feedstock in the conduit or tubing of a tube heater to a temperature above the cracking temperature while feeding the feedstock at a high velocity through the conduit. The optimum operation involves the use of feed rate such as to minimize the actual formation of carbon in the heated conduit of the tube heater. The tube heaters are often referred to interchangeably as coker heaters or coker preheaters and the terms are similarly used interchangeably in this description.

In U.S. Pat. No. 4,049,538 a coker preheater is illustrated diagrammatically as item number 11. In U.S. Pat. No. 4,547,284 a coker heater is illustrated diagrammatically as item number 25. The heated feedstock at the coking temperature is passed from the heating zone to a coke drum wherein preferably the majority of the coke formation takes place. In the insulated coke drum, or surge drum, a sufficient residence time allows the coking to take place. Typically, the heated coking feedstock has been heated to a temperature sufficient to maintain the coking in the drum, i.e. temperature in the range of about 750 to about 975° F. (399 to 524° C.). As the process proceeds, coke accumulates in the coking drum and is later removed by techniques known in the art.

Although much effort has been devoted in the past to providing conditions that will allow for the delayed coking feedstock to be heated to the cracking temperature without the formation of undesirable carbon deposits in the conduits or tubes of the coker heater, carbon deposition in the conduits of the coker heater still continues to be a problem.

As coke deposits in the conduit of the tube heater, the flow of feedstock through the heater is restricted. The restriction of flow can lead to increased residence time that in turn can lead to the deposition of additional coke. The coke deposits in turn tend to insulate the tube so that more heat must be applied to achieve the same rate of heating of the feedstock. In addition, the coke deposits cause the tubes to become much hotter. All these factors obviously tend to encourage the formation of still more coke within the tube of the tube heater further exacerbating the problem.

If the temperature of the tube increases enough, a tube rupture can occur. The likelihood of tube rupture is also

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aggravated by the fact that the feed must be pumped at ever-higher pressures as the flow is restricted by coke deposition in the tubes of the heater. The combination of exposing the tubes to higher temperatures and higher pressures greatly increases the probability of tube rupture and total shut down of the delayed coking process.

Because of the formation of coke deposits in the tubes of the heaters, operators of coke furnaces in the past have had to periodically shut down the operation and remove the coke that had been formed within the tubes of the heater.

It would be desirable if a cracking heater such as a coke furnace could be devised to minimize coke deposition within the heater tubes and increase the efficiency with which the feedstock in those tubes is heated. If such a furnace could be devised which additionally has reduced volume, this additional characteristic would be advantageous.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a typical schematic diagram of the refining process including a coker;

FIG. 2 is a cross-sectional side view of a coker heater containing an embodiment of the present invention;

FIG. 3 is a cross-sectional front view of a coker heater containing an embodiment of the present invention;

FIG. 4 is a diagram of one tube layout within a coking furnace according to the present invention in a non-limiting embodiment;

FIG. 5 is a diagram of the tube layout within a coking furnace according to the prior art using the same number of tubes as in FIG. 4; and

FIG. 6 is a diagram of one embodiment of a tube layout within a coking furnace according to the present invention showing portions of different arrangements;

It will be appreciated that the Figures are not necessarily to scale and that certain features are exaggerated to show detail, unless otherwise noted. It is also appreciated that any equipment not directly or critically related to the present invention is not shown in the drawings.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an improved delayed coking process in which the tendency for coke to be deposited in the tubes of the coke heater is greatly reduced.

It is another object of the present invention to provide a more efficient coke heater for a delayed coking process. A related object of the invention is to provide a coke heater that allows for a reduced residence time of the coking feedstock in the heater.

Still another object of the invention is to provide a coke heater that can be operated for extended periods of time without having to be taken off-line for coke removal.

Another object of the invention is to provide a coke heater that can provide the desired level of heating with a coke furnace of less overall height.

In carrying out these and other objects of the invention, there is provided, in one form, a cracking heater that has an enclosed housing including a substantially parallel front and back, a pair of substantially parallel sides which are perpendicular to the front and back and a top and bottom providing a continuous enclosure, at least one heat source, and an exhaust duct. The cracking heater also has a tube bundle including a plurality of continuous horizontal tubes parallel to the pair of sides, where the horizontal tubes are

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sequentially linked together by a plurality of tube bends and where at least a portion of the tubes are arranged in a plurality of vertical columns and are horizontally offset from one another. A feedstock is carried through the tubes beginning at a first end of the tube bundle and exiting at a second end of the tube bundle.

DETAILED DESCRIPTION OF THE INVENTION

It has been discovered that by staggering the tubes in a coking furnace, particularly a double-fired coker heater, that a number of advantages may be obtained. Coking furnaces or coker heaters are peculiar in refining operations. Factors such as heat flux patterns, coke deposition, vaporization of the cracked liquid fluid as it passes through the tubes, and retention time in the heater coil tubes above critical coking temperatures all have tremendous impact on the success of operations.

It will be appreciated that the invention is not limited to the arrangement of tubes in a coking furnace but could be applied to and used in any cracking heater. Cracking heaters may include, but are not necessarily limited to, coking furnaces, thermal crackers, ethylene crackers, visbreakers, and the like. Although the invention will be described herein with particular reference to coking furnaces, it will be understood that this is only for the purpose of illustrating the invention with respect to a particular, concrete embodiment, and does not necessarily limit the scope of the invention.

In a further particular embodiment of the invention, it will be appreciated that the invention will find its greatest utility in the radiant heating portion of a cracking heater. By radiant heating portion it should be understood that the primary method of heat transfer is by radiation as contrasted with other methods, such as by convection. Stated another way, the inventive apparatus and process are best practiced in a portion of a cracking heater where the primary method of heat transfer is by radiation and not convection.

It has been discovered that staggering the tube columns in various parts of the coking furnace, particularly the radiant tube section of a double-fired coker heater permits manipulation of the heat flux between groups of tubes. For instance, upper tubes in a radiant section farther from the burners often have conduction as the main heat transfer mechanism, rather than radiant heat transfer. Staggering the orientation of the upper tubes can bring them lower in the furnace so that more of the heat transfer to these tubes is radiant. As a result, more heat duty would be picked up by these lowered tubes and in which the fluid has not yet reached temperatures at which coke is rapidly deposited. If more heat is picked up in the upper radiant section that is less prone to coking, the furnace would not have to be fired as strongly, and the outlet tubes which have a greater tendency to coke deposition have a lower heat flux—thus decreasing the rate of coking.

Staggering the tubes in some portions of the radiant heat section and not in others permits manipulation of critical peak to average heat flux around the diameter of the tubes. For instance, by positioning the tubes according to the method of the invention, one can take advantage of the benefits of a staggered design in sections where slightly higher peak to average flux is not a difficulty, and reverting to the conventional single straight column in sections where analysis finds it to be more important. Thus, the staggering pattern of the instant invention permits flexibility of design and more design control for the designers.

Staggering the tubes according to the present invention also permits the use of longer radius return bends in the same

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heater configuration, thus reducing pressure drop through otherwise equivalent tube banks or bundles. In one non-limiting embodiment of the invention, 4 inch (10 cm) nominal long radius tube bends have a radius of twelve (12) inches or greater (30.5 cm or greater) center to center as opposed to standard designs using nominal short radius bends with 8 inches (20 cm) center to center. It will be appreciated that conventional "short radius" 180 degree return bends measure two times nominal diameter center to center. Thus, in a non-limiting example, 4" (10 cm) nominal tubes, short radius return bend is 8 inches (20 cm) center to center. Short radius tubes are generally used in "straight in line" radiant sections. Conversely, conventional "long radius" 180 degree return bends are considered to measure 3 nominal diameters center to center. Thus, for 4" (10 cm) nominal tubes, this dimension is 12 inches (30.5 cm). This ability gives several advantages. Lower pressure means more process fluid vaporization of cracked product, increasing velocity in the bottom tubes and reducing the duration of retention or residence time in the furnace at which the fluid temperature is high enough to possibly deposit coke in the heater tubes. Longer radius return bends also can result in lower erosion rates during decoking operations at the same velocities and particle loading, and thus improve coil life.

The staggered tube design of the instant invention also permits a reduction in height and volume of the fire box or radiant heat section of the coking furnace, which reduces cost. The fire box could be reduced in size about one-third to about one-fourth of the typical, conventional size, depending on the exact embodiment of the invention used. A shorter fire box is more efficient because there is less surface area and less heat loss. Fabrication costs would be reduced due to using less material. The costs for the foundation of the coking furnace would also be reduced since the coking furnace would weight less.

The invention will be described in more detail with respect to certain non-limiting embodiments shown in the Figures. FIG. 1 shows a refining process 100 including a coker. The crude oil is taken from the crude oil storage tank 1 and pumped through the initial crude heater 2. It is then run through an initial distillation tower 3 where the components are separated into butane and lighter 4, straight run gasoline 5, naphtha 6, kerosene 7, light gas oil 8, heavy oil 9 and straight run residue 10.

The products of the initial distillation are then further refined, used in other processes, or stored until shipped to a purchaser. The straight run residue 10 is pumped to the coker heater 11. Inside the coking furnace 11, straight run residue 10 is heated to a temperature of in between about 800 and about 1000° F. (427–538° C.). Ideally the outlet temperature is about 920° F. (493° C.) at the outlet, in one non-limiting embodiment. From the coking furnace 11 the product is then pumped into one of two coke drums 12 where the coke is allowed to form. The filling of the coke drums 12 is alternated so that once a drum is full it is allowed time to cool and the coke is allowed to solidify inside. The coke is then cut and removed from the coke drum 12. During the cooling and cutting cycle, the feedstock from the coking furnace 11 is fed into the opposite coke drum 12. Residual gases and vapor coming from the coke drums 12 are then taken over to the fractionator 13 which separates the product into C₄ and lighter 14, gasoline 15, naphtha 16 and gas oil 17. These products are then piped onto further processing, stored or used to operate the refinery.

FIG. 2 shows a cross-sectional side view of a cracking heater or coking furnace 11 containing the present invention. Coking furnace or coker heater 11 is an enclosed housing

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having substantially parallel front wall 30 and back wall 31, and a pair of substantially parallel sides 32, 33 (shown in FIG. 3) which are substantially perpendicular to the front 30 and back 31, and a top 34 and bottom 35 thus providing a continuous enclosure. The feedstock enters the coking furnace 11 through the heater inlet (first end) and convection section (not shown) and then to the radiant section 22 inlet 21. Radiant section 22 does not solely transmit heat to the feedstock in tubes 18 by radiant means, but does so predominantly by radiation, and thus this section 22 is termed a radiant section. Feedstock then flows through the radiant section 22 heater tubes 18. The plurality of horizontal heater tubes 18 are connected by a plurality of long radius bends 19 located at the ends of the heater tubes 18. The end of a heater tube 18 toward the front wall 30 is a front end 28, and the heater tube 18 end toward the back wall 31 is a back end 29. As noted, the generally horizontal heater tubes 18 are sequentially linked by the tube bends 19. The feedstock then leaves the coking furnace 11 at the heater outlet (second end) 20. The overall height of the coking furnace radiant section 22 of cracking heater structure 11 is shown as dimension A. The alternate tube arrangement of the invention permits A to be reduced from that of a conventional coking furnace. Although FIG. 2 shows that the feedstock enters the top of the coking furnace 11 (heater inlet 21 is at the top) and exits the bottom of the coking furnace 11 (outlet 20 is at the bottom), the invention is not necessarily limited to this configuration, although this is the more conventional flow direction. It is anticipated that the invention could be used in a design where the feedstock flows the other direction.

FIG. 3 shows a cross-sectional view of a coking furnace 11 containing the present invention. The heater tubes 18 and the long radius bends 19 which connect them are located in the center of the coking furnace 11 in two vertical columns, although it will be appreciated that the invention anticipates a plurality of vertical columns, not necessarily only two. It will further be appreciated that the vertical columns of tubes 18 are not necessarily strictly vertical but are only generally vertical in arrangement. For instance, the tube bundle portion 37 shown in the upper part of FIG. 6 are within the scope of the invention, even though they are not truly vertical. The heater tubes are generally parallel to the sides 32 and 33 of the coking furnace 11. The heater tubes 18 as viewed "end on" in FIG. 3 are horizontally and vertically displaced from the heater tubes 18 in the other column, and thus have a "staggered" configuration with respect to each other. The particular heater tubes 18 in FIG. 3 are shown with a 12-inch (30.5 cm) displacement B between 4" (10 cm) diameter heater tubes 18 and the long radius bends are at a 60° angle C from each other. In other words, an angle C is formed between the center of one tube 18 as the vertex extending to the two closest tubes 18 in the vertical column adjacent the tube (but displaced vertically and horizontally therefrom to give the "staggered" appearance), where the angle C is less than 180°. If C was zero degrees, the tubes are filly side-by-side, and if C was 180 degrees C would be current, straight vertical in-line design. A possible preferred version would have an angle range between 80 and 40 degrees. In another non-limiting preferred angle range C may range from about 70° to about 50°. All of the tubes 18 may be collectively known as a tube bundle 36.

Also shown in FIG. 3 are burners 24 and flames 25 located on each side of the tube bundle, between the tube bundle and the side walls 32 and 33 of the coking furnace 11. The burners 24 are supplied with fuel by the fuel lines 23. The flue gas 26 from the burners 24 is shown exiting the coking furnace radiant section 22 of coking furnace 11 via exhaust

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duct 27 typically to the coking furnace 11 convection section. Exhaust duct 27 is any channel or mechanism or device useful in removing flue gas 26 from the coking furnace 11 and need not be a conventional duct having a rectangular cross-section.

It will be appreciated that in the particular embodiments shown in FIGS. 2 and 3 that the tube bundle 36 is in the radiant heating section 22 of the coking furnace 11.

FIG. 4 shows the tube bundle 36 of twenty-five (25) heater tubes 18 in accordance with the present invention. As discussed with respect to FIG. 3, the angle between the long radius bends 19 is indicated by C. The spacing between the heater tubes 18 is indicated by dimension B. FIG. 4 was drawn to scale to show an angle C of 60° and spacing B of 12 inches (30.5 cm) with 4 inch (10 cm) diameter heater tubes 18, in one non-limiting embodiment.

FIG. 5 shows a heater tube 18' arrangement of the prior art drawn to the same scale as FIG. 4 and also using 25 tubes. FIG. 5 is additionally drawn to show 4 inch (10 cm) diameter heater tubes 18' with a spacing B' of 8 inches (20 cm). It will be appreciated that using the alternate coking furnace tube arrangement of the invention shown in FIG. 4 with two offset vertical columns that an appreciably shorter tube bundle containing the same number of tubes 18 would occupy about 148 inches (3.76 m) of vertical height D. In contrast, where tubes 18' are arranged in one vertical column as is conventional, the tube bundle 36' has a vertical height D' of about 196 inches (4.98 m). Stated another way, using the alternate tube arrangement of the invention, the vertical height of the tube bundle 36' can be reduced to approximately 75% of its initial height.

It will be appreciated that staggering or offset positioning of the tubes 18 permits the size of the coking furnace 11 to be reduced, and also increases the radiant heat transfer to the upper tubes 18 in the tube bundle 36 by bringing these tubes closer to the heat source. Alternatively, the coking furnace 11 may not have to be fired as hard to heat the feedstock. As discussed above, an overall effect of the inventive arrangement of the heating tubes 18 is to decrease the rate of undesirable coking or deposition of solids within the tubes 18.

Additionally, as noted, the inventive tube arrangement permits the use of longer radius tube bends. In the to-scale drawing of FIG. 4, not only is dimension B, the vertical distance between tubes 18 in a vertical column greater (12" or 30.5 cm in this non-limiting example), but the distance E between the tubes 18 taken along the direction of the tube bend 19 is also 12" (30.5 cm) in this non-limiting example). That is, the radius of the tube bend 19 can be larger, such as 12" (30.5 cm) or more. It will be appreciated, however, that it is not necessary for dimension B and dimension E to be equal. It just happens that in the embodiment of the invention shown in FIGS. 3 and 4 looking at the tube bundle 36 and tubes 18 in cross-section the tubes 18 form a vertical column of alternating equilateral triangles where not only is angle C 60°, but all angles of the three nearest tubes 18 are also 60°.

For instance, it is entirely possible that distance E could be 16 inches (40.6 cm) for an even longer radius tube bend 19, but distance B between adjacent tubes 18 in one of the vertical columns to still be 12 inches (30.5 cm). In this embodiment, angle C would be less than 60° (about 44°). The triangles formed by tubes 18 would not be stacked, alternating equilateral triangles, but rather stacked, alternating isosceles triangles.

In the foregoing specification, the invention has been described with reference to specific embodiments thereof,

and is expected to be effective in providing methods and apparatus for heating coking feedstock in a coking furnace with an alternate heating tube arrangement that is more efficient and less prone to coke deposition in the tube bundle. However, it will be evident that various modifications and changes can be made thereto without departing from the broader spirit or scope of the invention as set forth in the appended claims. Accordingly, the specification is to be regarded in an illustrative rather than a restrictive sense. For example, specific combinations of conventionally arranged, single-column planar serpentine tube bundles with double vertical staggered columns of tubes in accordance with this invention may be used. Further, tube bundles having different dimensions B, C, D, and E from those illustrated and discussed may be used. Indeed, it will be appreciated that these dimensions may vary within the same tube bundle design and that the overall tube bundle would still be within the scope of the invention as claimed. It is possible to envision a tube bundle where each progressive tube bend increases in diameter along the flow path as the feedstock temperature increases, or conversely decreases. For instance, FIG. 6 illustrates one non-limiting example of a tube bundle 36" in accordance with this invention that has the same number of tubes (25) as in FIGS. 4 and 5, where there is an upper tube bundle portion 37 with tube bends 19 of varying radii. Within such a portion, dimensions B, C, D, and E would change with each pair of adjacent tubes 18. Within the same bundle 36", middle tube bundle portion 38 with tube bends 19 of same radii in two straight columns would be similar to the embodiment shown in FIG. 4, where as tube bundle portion 39 with tubes 18 in conventional single column as is in conventional as shown in FIG. 5.

I claim:

1. A cracking heater comprising:

an enclosed housing comprising a substantially parallel front and back, a pair of substantially parallel sides, which are perpendicular to the front and back and a top and bottom providing a continuous enclosure;

at least one heat source;

an exhaust duct; and

a tube bundle comprising a plurality of continuous horizontal tubes parallel to the pair of sides, the horizontal tubes sequentially linked together by a plurality of tube bends and where at least a portion of the tubes are arranged in a plurality of vertical columns and are horizontally offset from one another, wherein a feedstock is carried through the tubes beginning at a first end of the tube bundle and exiting at a second end of the tube bundle.

2. The cracking heater of claim 1 where at least one heat source is located on each side of the tube bundle between the tube bundle and the respective side.

3. The cracking heater of claim 1 where the tubes have a nominal radius and where the tube bends have a radius of greater than twice the nominal radius.

4. The cracking heater of claim 1 where the feedstock is carried through the tubes beginning at the top of the tube bundle and exiting at the bottom of the tube bundle.

5. The cracking heater of claim 1 where in the portion of the tubes in the plurality of vertical columns, an angle C is formed between the center of one tube as the vertex extending to the two closest tubes in the vertical column adjacent the tube, where the angle C is less than 180°.

6. The cracking heater of claim 5 where within each vertical column adjacent tubes are separated by a distance B, and within each pair of tubes linked by a tube bend there is distance E separating the tubes in the direction of the tube bend, where E is greater than or equal to B.

7. The cracking heater of claim 5 where for all tubes in the portion of the tubes in the plurality of vertical columns, the angle C is less than 180°.

8. The cracking heater of claim 5 where the angle C is between about 80° and 40°.

9. The cracking heater of claim 1 where the cracking heater is a coking furnace and where the portion of the tubes in the plurality of vertical columns resides in a radiant heating section of the coking furnace.

10. The cracking heater of claim 1 wherein an upper portion of the tube bundle has tube bends of varying radii.

11. A cracking heater comprising:

an enclosed housing comprising a substantially parallel front and back, a pair of substantially parallel sides, which are perpendicular to the front and back and a top and bottom providing a continuous enclosure;

an exhaust duct;

a tube bundle comprising a plurality of continuous horizontal tubes parallel to the pair of sides each with a front end and a back end, the horizontal tubes linked together by a plurality of tube bends at the front end and the back end and arranged in a plurality of vertical columns and horizontally offset from one another, wherein the feedstock is carried through the tubes beginning at a first end of the tube bundle and exiting at a second end of the tube bundle, where in the portion of the tubes in the plurality of vertical columns, an angle C is formed between the center of one tube as the vertex extending to the two closest tubes in the vertical column adjacent the tube, where the angle C is less than 180°; and

at least one heat source disposed between the tube bundle and each of the sides.

12. The coking furnace of claim 11 where the tubes have a nominal radius and where the tube bends have a radius of greater than twice the nominal radius.

13. The cracking heater of claim 11 where the feedstock is carried through the tubes beginning at the top of the tube bundle and exiting at the bottom of the tube bundle.

14. The cracking heater of claim 11 where within each vertical column adjacent tubes are separated by a distance B, and within each pair of tubes linked by a tube bend there is distance E separating the tubes in the direction of the tube bend, where E is greater than or equal to B.

15. The cracking heater of claim 11 where for all tubes in the portion of the tubes in the plurality of vertical columns, the angle C is less than 180°.

16. The cracking heater of claim 11 where the cracking heater is a coking furnace.

17. The cracking heater of claim 11 where the cracking heater is a coking furnace and where the portion of the tubes in the plurality of vertical columns resides in a radiant heating section of the coking furnace.

18. The coking furnace of claim 11 where the portion of the tubes in the plurality of vertical columns extends the entire height of the tube bundle.

19. A delayed coking charge heater for heating a coker feedstock comprising:

a first convection section;

a second radiant section adjacent to said first convection section; said second section transmitting heat to said feedstock predominantly by radiant means;

a heating conduit in said radiant section comprising a plurality of horizontal heater tubes located in the center of the coking heater and horizontally vertically offset from one another so as to form double vertical columns;

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wherein said heater tubes are sequentially linked by tube bends so as to form a tube bundle; and

a plurality of burners located on each side of said heater tubes.

20. A heater according to claim 19 wherein said heating conduit comprises a plurality of continuous and generally horizontal tubes sequentially linked together by a plurality of tube bends extending from a heater inlet at the top of said radiant section to an outlet at the bottom of said radiant section.

21. A heater according to claim 20 wherein at least a portion of said tubes are arranged in two offset vertical columns having a serpentine pattern.

22. A heater according to claim 21 wherein said heater tubes are horizontally and vertically displaced so as to have a staggered configuration.

23. A heater according to claim 19 wherein said heating conduit comprises a plurality of continuous and generally horizontal tubes sequentially linked together by a plurality of tube bends extending from an upper portion of said radiant section to outlet tubes in the lower portion of said radiant section.

24. A heater according to claim 23 wherein said plurality of continuous and generally horizontal tubes sequentially linked together by a plurality of tube bends have a serpentine pattern.

25. A heater according to claim 24 wherein said plurality of continuous and generally horizontal tubes sequentially linked together by a plurality of tube bends are horizontally and vertically displaced so as to have a staggered configuration.

26. A heater according to claim 19 wherein said burners are located in a lower portion of said radiant section on each side of the conduit, between the conduit and the side walls.

27. A delayed coking heater for heating a coking feedstock comprising:

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a first convection section;

a second radiant section adjacent to said first convection section, said second section transmitting heat to said feedstock by radiant means;

a feedstock heater inlet at the bottom of said radiant section;

a heating conduit in said radiant section comprising a plurality of horizontal heater tubes where at least a portion of said heater tubes are arranged in a plurality of vertical columns and are horizontally and vertically offset from one another and where said horizontal tubes are sequentially linked by tube bends to allow flow of feedstock from the bottom to the top of said heater;

a heater outlet at the top of said radiant section; and

a plurality of burners located in a lower portion of said radiant section on each side of said heater tubes.

28. A heater according to claim 27 further comprising a plurality of conventionally arranged single column planar tube bundles.

29. A heater according to claim 27 wherein said heating conduit comprises double vertical staggered columns.

30. A heater according to claim 29 further comprising a plurality of vertical columns.

31. A heater according to claim 27 wherein said heating conduit comprises a plurality of continuous and generally horizontal tubes sequentially linked together by a plurality of tube bends extending from a heater inlet at the bottom of said radiant section to an outlet at the top of said radiant section.

32. A heater according to claim 31 wherein at least a portion of said tubes are arranged in two offset vertical columns having a serpentine pattern.

* * * * *

PATENT

Attorney Docket No. ICR 97/026

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Brian Jay DOERKSEN)	
)	
Application No.: 09/872,390)	Group Art Unit: 1764
)	
Filed: June 1, 2001)	Examiner: Alexa A. Doroshenk
)	
For: ALTERNATE COKE FURNACE TUBE)	
ARRANGEMENT)	

AMENDMENT AND RESPONSE UNDER 37 CFR §1.111
TO OFFICE ACTION MAILED 10/28/2003

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DOCKETED
MAY 11 2004
C. Ratcliffe

Sir:

In response to the Office Action mailed 10/28/2003, Applicant submits the following amendments, remarks and declaration under 37 CFR § 1.131, and petition under 37 CFR § 136 for a three-month extension of the time to respond. The Examiner is requested to enter the following amendments and consider the accompanying remarks and declaration. Reconsideration is respectfully requested.

Amendments to the claims are reflected in the listing of claims that begins on page 3 of this paper.

Remarks begin on page 13 of this paper.

Enclosed with this paper is a Declaration of Brian Jay Doerksen under 37 CFR § 1.131 together with supporting exhibits.

COPY

MAR 9 2005

Also enclosed with this paper are:

- three (3) sheets of proposed substitute drawings, together with three (3) sheets of drawings as filed marked in red ink to show proposed changes; and
- a copy of the Preliminary Amendment filed on June 5, 2003, which added claims 25-38.

Additionally enclosed with this paper is a petition under 37 CFR § 1.136 for a three month extension of the time to respond, together with a Fee Transmittal form in duplicate authorizing the Commissioner to charge the petition fee under 37 CFR § 1.17(a)(3) for the extension, the extra claim fee under 37 CFR § 1.16(j) for new claim 39, and any other fees that may be due to Deposit Account Number 16-1575, ConocoPhillips Company, Houston, Texas.

AMENDMENT TO THE CLAIMS:

1. [Currently Amended] A cracking heater comprising:
an enclosed housing comprising a substantially parallel front and back, a pair of substantially parallel sides, which are perpendicular to the front and back and a top and bottom providing a continuous enclosure;
at least one heat source;
an exhaust duct; and
a tube bundle comprising a plurality of continuous horizontal tubes parallel to the pair of sides, the horizontal tubes sequentially linked together by a plurality of tube bends and where at least a portion of the tubes are arranged in a plurality of vertical columns and are horizontally and vertically offset from one another, wherein a feedstock is carried through the tubes beginning at a first end of the tube bundle and exiting at a second end of the tube bundle.
2. [Original] The cracking heater of claim 1 where at least one heat source is located on each side of the tube bundle between the tube bundle and the respective side.
3. [Original] The cracking heater of claim 1 where the tubes have a nominal radius and where the tube bends have a radius of greater than twice the nominal radius.
4. [Original] The cracking heater of claim 1 where the feedstock is carried through the tubes beginning at the top of the tube bundle and exiting at the bottom of the tube bundle.
5. [Original] The cracking heater of claim 1 where in the portion of the tubes in the plurality of vertical columns, an angle C is formed between the center of one tube as

the vertex extending to the two closest tubes in the vertical column adjacent the tube, where the angle **C** is less than 180°.

6. [Original] The cracking heater of claim 5 where within each vertical column adjacent tubes are separated by a distance **B**, and within each pair of tubes linked by a tube bend there is a distance **E** separating the tubes in the direction of the tube bend, where **E** is greater than or equal to **B**.

7. [Original] The cracking heater of claim 5 where for all tubes in the portion of the tubes in the plurality of vertical columns, the angle **C** is less than 180°.

8. [Original] The cracking heater of claim 5 where the angle **C** is between about 80° and 40°.

9. [Original] The cracking heater of claim 1 where the cracking heater is a coking furnace and where the portion of the tubes in the plurality of vertical columns resides in a radiant heating section of the coking furnace.

~~10.~~ [Currently Amended] A cracking heater comprising:

an enclosed housing comprising a substantially parallel front and back, a pair of substantially parallel sides, which are perpendicular to the front and back and a top and bottom providing a continuous enclosure;

an exhaust duct;

a tube bundle comprising a plurality of continuous horizontal tubes parallel to the pair of sides each with a front end and a back end, the horizontal tubes linked together by a plurality of tube bends at the front end and the back end and arranged in a plurality of vertical columns and horizontally and vertically offset from one another, wherein the feedstock is carried through the tubes beginning at a first end of the tube bundle and exiting at

a second end of the tube bundle, where in the portion of the tubes ⁱⁿ the plurality of vertical columns, an angle **C** is formed between the center of one tube as the vertex extending to the two closest tubes in the vertical column adjacent the tube, where the angle **C** is less than 180°; and
at least one heat source disposed between the tube bundle and each of the sides.

~~11~~ [Original] The coking furnace of claim 10 where the tubes have a nominal radius and where the tube bends have a radius of greater than twice the nominal radius.

~~12~~ [Original] The cracking heater of claim ¹¹10 where the feedstock is carried through the tubes beginning at the top of the tube bundle and exiting at the bottom of the tube bundle.

~~13~~ [Original] The cracking heater of claim ¹¹10 where within each vertical column adjacent tubes are separated by a distance **B**, and within each pair of tubes linked by a tube bend there is distance **E** separating the tubes in the direction of the tube bend, where **E** is greater than or equal to **B**.

~~14~~ [Original] The cracking heater of claim ¹¹10 where for all tubes in the portion of the tubes in the plurality of vertical columns, the angle **C** is less than 180°.

~~15~~ [Original] The cracking heater of claim ¹¹10 where the cracking heater is a coking furnace.

~~16~~ [Original] The cracking heater of claim ¹¹10 where the cracking heater is a coking furnace and where the portion of the tubes in the plurality of vertical columns resides in a radiant heating section of the coking furnace.

~~17~~ [Original] The coking furnace of claim ¹¹10 where the portion of the tubes in the plurality of vertical columns extends the entire height of the tube bundle.

18. [Withdrawn] A process for heating a feedstock comprising:

providing a cracking heater having:

an enclosed housing comprising a substantially parallel front and back, a pair of substantially parallel sides, which are perpendicular to the front and back and a top and bottom providing a continuous enclosure,

at least one heat source,

an exhaust duct, and

a tube bundle comprising a plurality of continuous horizontal tubes parallel to the pair of sides, the horizontal tubes sequentially linked together by a plurality of tube bends and where at least a portion of the tubes are arranged in a plurality of vertical columns and are horizontally offset from one another; and

carrying a feedstock through the tubes beginning at a first end of the tube bundle and exiting at a second end of the tube bundle.

19. [Withdrawn] The process of claim 18 where carrying the feedstock through the tubes is accomplished beginning at the top of the tube bundle and exiting at the bottom of the tube bundle.

20. [Withdrawn] The process of claim 18 where in providing the cracking heater, the portion of the tubes in the plurality of vertical columns, an angle C is formed between the center of one tube as the vertex extending to the two closest tubes in the vertical column adjacent the tube, where the angle C is less than 180°.

21. [Withdrawn] The process of claim 18 further comprising maintaining the cracking heater by cleaning out coke deposited inside the tubes where the maintaining is performed at a time interval less frequently than on identical number of identical tubes in

a cracking heater where all of the tubes are arranged in a single vertical column operated at identical temperature.

22. [Withdrawn] The process of claim 18 where in providing the cracking heater, the tubes have a nominal radius and where the tube bends have a radius of greater than twice the nominal radius.

23. [Withdrawn] The process of claim 18 where in providing the cracking heater, cracking heater has a height which is less than the height of a cracking heater where all of the tubes are arranged in a single vertical column.

24. [Withdrawn] The process of claim 18 where in providing the cracking heater, the heat transfer to the feedstock is more efficient as compared with the heat transfer in a cracking heater where all of the tubes are arranged in a single vertical column operated at identical temperature.

19. 25. [Currently Amended] A delayed coking charge heater for heating a coker feedstock comprising:

a first convection section;

a second radiant section adjacent to said first convection section; said second section transmitting heat to said feedstock predominantly by radiant means;

a heating conduit in said radiant section comprising a plurality of horizontal heater tubes located in the center of the coking heater and horizontally and vertically offset from one another so as to form double vertical columns;

wherein said heater tubes are sequentially linked by tube bends so as to form a tube bundle; and

a plurality of burners located on each side of said heater tubes.



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NOTICE OF ALLOWANCE AND FEE(S) DUE

7590

10/05/2004

Anne E. Brookes
P.O. Box 4783 Zip Code: 77210-4783
600 North Dadiry Ashford
Houston, TX 77079-1175

EXAMINER

DOROSHENK, ALEXA A

ART UNIT

PAPER NUMBER

1764

DATE MAILED: 10/05/2004

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/872,390	06/01/2001	Brian Jay Doerksen	ICR 97/026	2876

TITLE OF INVENTION: ALTERNATE COKE FURNACE TUBE ARRANGEMENT

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1370	\$300	\$1670	01/05/2005

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. **PROSECUTION ON THE MERITS IS CLOSED.** THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN **THREE MONTHS** FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. **THIS STATUTORY PERIOD CANNOT BE EXTENDED.** SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE REFLECTS A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE APPLIED IN THIS APPLICATION. THE PTOL-85B (OR AN EQUIVALENT) MUST BE RETURNED WITHIN THIS PERIOD EVEN IF NO FEE IS DUE OR THE APPLICATION WILL BE REGARDED AS ABANDONED.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL should be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). Even if the fee(s) have already been paid, Part B - Fee(s) Transmittal should be completed and returned. If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

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PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail**

**Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
(703) 746-4000**

or **Fax**

INSTRUCTIONS: This form should be used for transmitting the **ISSUE FEE** and **PUBLICATION FEE** (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

7590

10/05/2004

Anne E. Brookes
P.O. Box 4783 Zip Code: 77210-4783
600 North Dairy Ashford
Houston, TX 77079-1175

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (703) 746-4000, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/872.390	06/01/2001	Brian Jay Doerksen	ICR 97/026	2876

TITLE OF INVENTION: ALTERNATE COKE FURNACE TUBE ARRANGEMENT

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1370	\$300	\$1670	01/05/2005

EXAMINER	ART UNIT	CLASS-SUBCLASS
DOROSHENK, ALEXA A	1764	422-198000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47: Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list

- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1	_____
2	_____
3	_____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are enclosed:

- ☐ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s):

- ☐ A check in the amount of the fee(s) is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☐ The Director is hereby authorized by charge the required fee(s), or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

The Director of the USPTO is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above. NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant, a registered attorney or agent, or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/872,390	06/01/2001	Brian Jay Doerksen	ICR 97/026	2876
7590 10/05/2004			EXAMINER	
Anne E. Brookes P.O. Box 4783 Zip Code: 77210-4783 600 North Dairy Ashford Houston, TX 77079-1175			DOROSHENK, ALEXA A	
			ART UNIT	PAPER NUMBER
			1764	
DATE MAILED: 10/05/2004				

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 299 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 299 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (703) 305-1383. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (703) 305-8283.

MAR 9 2005



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/872,390	06/01/2001	Brian Jay Doerksen	ICR 97/026	2376
7590	10/05/2004			
Anne E. Brookes P.O. Box 4783 Zip Code: 77210-4783 600 North Dairy Ashford Houston, TX 77079-1175				
			EXAMINER DOROSHENK, ALEXA A	
			ART UNIT 1764	PAPER NUMBER
DATE MAILED: 10/05/2004				

Notice of Fee Increase on October 1, 2004

If a reply to a "Notice of Allowance and Fee(s) Due" is filed in the Office on or after October 1, 2004, then the amount due will be higher than that set forth in the "Notice of Allowance and Fee(s) Due" because some fees will increase effective October 1, 2004. See Revision of Patent Fees for Fiscal Year 2005; Final Rule, 69 Fed. Reg. 52604, 52606 (May 10, 2004).

The current fee schedule is accessible from WEB site (<http://www.uspto.gov/main/howtofees.htm>).

If the fee paid is the amount shown on the "Notice of Allowance and Fee(s) Due" but not the correct amount in view of the fee increase, a "Notice of Pay Balance of Issue Fee" will be mailed to applicant. In order to avoid processing delays associated with mailing of a "Notice of Pay Balance of Issue Fee," if the response to the Notice of Allowance is to be filed on or after October 1, 2004 (or mailed with a certificate of mailing on or after October 1, 2004), the issue fee paid should be the fee that is required at the time the fee is paid. See Manual of Patent Examining Procedure (MPEP), Section 1306 (Eighth Edition, Rev. 2, May 2004). If the issue fee was previously paid, and the response to the "Notice of Allowance and Fee(s) Due" includes a request to apply a previously-paid issue fee to the issue fee now due, then the difference between the issue fee amount at the time the response is filed and the previously-paid issue fee should be paid. See MPEP Section 1308.01.

Effective October 1, 2004, 37 CFR 1.18 is amended by revising paragraphs (a) through (c) to read as set forth below.

Section 1.18 Patent post allowance (including issue) fees.

- (a) Issue fee for issuing each original or reissue patent, except a design or plant patent:
- By a small entity (Sec. 1.27(a))..... \$685.00
 - By other than a small entity..... \$1,370.00
- (b) Issue fee for issuing a design patent:
- By a small entity (Sec. 1.27(a))..... \$245.00
 - By other than a small entity..... \$490.00
- (c) Issue fee for issuing a plant patent:
- By a small entity (Sec. 1.27(a))..... \$330.00
 - By other than a small entity..... \$660.00

Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (703) 305-8283.

Notice of Allowability	Application No.	Applicant(s)	
	09/872,390	DOERKSEN, BRIAN JAY	
	Examiner	Art Unit	
	Alexa A. Doroshenk <i>AD</i>	1764	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the response of June 30, 2004.
2. ☒ The allowed claim(s) is/are 1-17 and 25-39.
3. ☒ The drawings filed on 28 April 2004 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|---|---|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date _____ |
| 3. <input type="checkbox"/> Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date _____ | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input type="checkbox"/> Other _____ |

ALLOWANCE

Election/Restrictions

1. Applicant's election of Group I, claims 1-17 and 25-38 in the reply filed on June 30, 2004 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Drawings

2. The drawings were received on April 28, 2004. These drawings are acceptable and overcome the objections in the Office Action dated October 28, 2003.

Examiner's Amendment

3. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

The application has been amended as follows:

Claims 18-24 have been cancelled.

The abstract has been replaced with the following abstract ---

Tubes within a radiant heating section of a coking furnace are arranged differently than in a single vertical column and connected together in a simple, planar serpentine pattern. The tubes are arranged in a plurality of offset or staggered vertical

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columns. This arrangement permits the upper tubes to be close to the radiant heat source and also allows the tube bends connecting adjacent tubes to be of greater radius, so that the pressure at which the feedstock is passed through the tube bundle can be lower allowing more vaporization of the cracked process fluids. ---

4. The following is an examiner's statement of reasons for allowance: The declaration of Brian Jay Doerksen under 37 CFR §1.131 has been considered and found to overcome the effective dates of references Barnett et al. and Gibson et al. applied under 35 USC §102(e).

5. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alexa A. Doroshenk whose telephone number is 571-272-1446. The examiner can normally be reached on Monday - Thursday from 9:00 AM - 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn Caldarola can be reached on 571-272-1444. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Alexa A. Doroshenk
Examiner
Art Unit 1764

MAR 9 2005

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

97/026

PATENT NO : 6,852,294 B2
DATED : Feb. 8, 2005
INVENTOR(S) : Brian Jay Doerksen

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Col. 7, line 45, after "horizontally" insert --and vertically--.

Col. 8, line 23, after "horizontally" insert --and vertically--.

Col. 8, line 65, after "horizontally" insert --and--.

MAILING ADDRESS OF SENDER: Anne E. Brookes, Esq.
ConocoPhillips Company
Intellectual Property Legal
P.O. Box 2443
Bartlesville, OK 74005

PATENT NO. 6,852,294

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